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Article

Rethinking Fuelwood: People, Policy and the Anatomy of a Charcoal Supply Chain in a Decentralizing Peru

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Abstract: In Peru, as in many developing countries, charcoal is an important source of fuel. We examine the commercial charcoal commodity chain from its production in Ucayali, in the Peruvian Amazon, to its sale in the national market. Using a mixed-methods approach, we look at the actors involved in the commodity chain and their relationships, including the distribution of benefits along the chain. We outline the obstacles and opportunities for a more equitable charcoal supply chain within a multi-level governance context. The results show that charcoal provides an important livelihood for most of the actors along the supply chain, including rural poor and women. We find that the decentralisation process in Peru has implications for the formalisation of charcoal supply chains, a traditionally informal, particularly related to multi-level institutional obstacles to equitable commerce. This results in inequity in the supply chain, which persecutes the poorest participants and supports the most powerful actors.

Keywords: charcoal; fuelwood; Amazon; Peru; sustainability; poverty; policy

1. Introduction

In Peru, as in most developing nations, many urban and rural households rely on woodfuels for energy needs. Woodfuels are biofuels originating directly or in-directly from woody biomass including fuelwood and charcoal (Schure et al. 2012). Fuelwood (and especially charcoal) can be an important source of cash income for both rural and urban poor [1] who mainly produce charcoal for consumption in large urban hubs [2]. Historically, the primary charcoal producing area in Peru was in the dry forests of the northwest, where *algarrobo* (carob—*Prosopis pallida* (Humb. & Bonpl. Ex Willd.) Kunth) was the main species used. However, as a response to the heavy deforestation caused by charcoal production in the northern region, the central government, with the support of regional authorities, made all aspects of *algarrobo* charcoal production from the felling of the trees to the transformation, transport and trade of charcoal illegal. Whilst the government invested considerable resources in preventing, monitoring and sanctioning such activities in the north, an unexpected ‘leakage effect’ occurred when this new gap in the market was filled by the Amazon region, and particularly the department of Ucayali [2]. Official estimates report an increase in charcoal production in Ucayali from just under 370,000 kg in 2011 [3] to over 33,000,000 kg in 2014 [4]. Thus, despite once being a small player in charcoal production in Peru, by 2017 Ucayali ranked as the biggest producer region in the country, producing almost double the second biggest producing department, Lambayeque.

As charcoal production increased in the Amazon basin, concerns were raised by national, regional and grassroots groups about the possible socio-environmental impact it might have. This paper reports on the second phase of an in-depth study on production and trade of charcoal from Ucayali to national markets. The first phase of the study focused on the environmental impact, and found that in fact charcoal production was not causing large-scale deforestation, as it was mainly taking place in the urban periphery of the capital city Pucallpa, where sawmill waste wood was being used to produce the charcoal [2]. In response to that study, in 2013 the regional government changed its annual reporting on charcoal to the national government, finally distinguishing between charcoal made from wood in natural forests, and charcoal made using sawmill waste.

The first phase of the research indicated that livelihoods of various types were being generated along the charcoal supply chain, from the Amazon to Lima. However, supply chains that involve both informal and formal aspects are notorious for inequality and insecurity in terms of the distribution of benefits among actors involved [5,6], and little is known about these processes with charcoal in Peru and elsewhere. Such inequality can be exacerbated where massive shifts in government administration are taking place, such as the decentralization of a federal state [5] as is the case in Peru. In such a scenario, there are usually rapid legal and administrative shifts that strive to either incorporate informal economies into a formal system, or sanction informal market activities without necessarily understanding the status quo of production and trade. The presence of informal institutions and powerful actors at different levels can influence how those changes are manifested in practice, who benefits and who retains or gains power [5,7]. The literature on multi-level governance highlights the essential role of non-state actors in the decision-making process [8] and the potential for better environmental outcomes from multi-level and/or polycentric governance models [9,10]. Thus, the second phase of the study was to look at the informal and formal socio-economic ‘anatomy’ of the supply chain, within the context of a decentralizing state where forest resources are governed at different levels by multiple actors.

Understanding the means of production and exchange of forest commodities that are largely informal in nature can be important for reconciling poverty alleviation objectives [11]. If policy makers do not understand the relationships and power dynamics along the supply chain, or choose not to act to counter the imbalance of power, elite capture of both benefits [12] and political decision-making power is more likely [13]. As such, this study addresses four central questions aimed at understanding the dynamics of the charcoal commodity chain and how it fits within multi-level governance structures in place:

1. Who are the actors along the supply chain and what are their roles?
2. How are activities and relations distributed amongst and utilized by those actors?
3. How are economic and power benefits in charcoal trade distributed amongst actors?
4. What are the obstacles and opportunities for a more equitable charcoal supply chain within a multi-level governance context?

We hold that the manner in which local markets are interpreted or misinterpreted by authorities can be illustrated by reflecting on the government’s approach to natural resource management and policy and as such use the case of charcoal in a decentralizing Peru to reflect on this issue. Recommendations based on identified obstacles and opportunities are relevant to other supply chains and other countries undergoing decentralization or major changes in their multi-level governance frameworks.

We analyse the division of labour, the distribution of benefits, the nature of those benefits and how the patterns of benefit distribution might be encouraged, changed or controlled [14]. By tracing the sequence of social and economic exchange along the Amazon-Lima commercial charcoal supply chain, this article examines the structure and operation as well as the socio-economic dynamic of this commercial charcoal commodity chain.

2. Study Site

This study focuses primarily on charcoal sourced in Peru's Amazonian department Ucayali, and traded through the regional capital Pucallpa to Lima, the national capital (Figure 1). Ucayali was selected for this study having been highlighted in a Centre for International Forestry Research (CIFOR) report as a key source region for charcoal supply to the capital [15]. The report suggested that national statistics about charcoal were inaccurate (*ibid*).

Pucallpa is the capital city of Ucayali, and is the heart of Ucayali's timber industry representing Peru's largest timber milling center. The 846 km Federico Basadre Highway links Pucallpa to Lima, making it the Amazon's most accessible regional capital. The landscape around Pucallpa is a heterogeneous mix of small and large farms, forest fallows, remnant forest patches and vast stretches of mature rainforest. Ucayali's economy is mainly based on agriculture and extraction of natural resources such as minerals and timber [16]. Processing industries provide 45% of the employment in Ucayali, mostly in the forest sector [17].

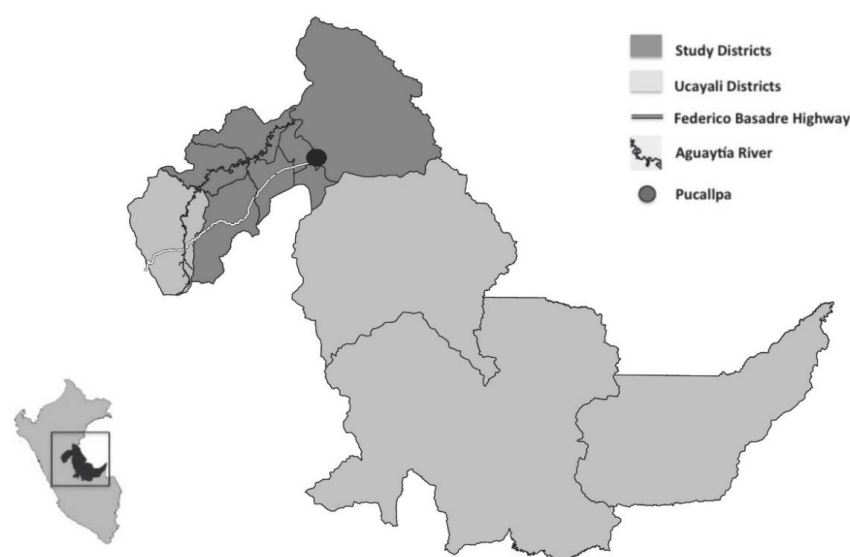


Figure 1. Study site map.

Many Pucallpino households are multi-local, maintaining both rural and urban homesteads to access public services, such as education and medical care available in population centers while also farming on small agricultural landholdings (*chacras*) for subsistence and commercial production [18,19]. This livelihood strategy means that cash-based economic activities like charcoal production are an important income supplement for many rural, peri-urban and urban residents in the area, making this site an optimal choice for the central questions proposed.

3. Method

3.1. Non-Probability Sampling and Choosing Informants

Since most Amazon charcoal commerce is an informal economic activity, no official registry of people involved in production or distribution existed, and very little reliable information was available even at the wholesale trade end. As such, a systematic randomised sample was not possible for this study and thus we opted for a purposive snowball sampling method. This sampling method is the most appropriate approach for labour-intensive, in-depth studies of smaller numbers of cases, focussed on cultural data where cases are chosen based on purpose, not randomly [20].

Purposive sampling involves first determining the information required to answer the research questions, and then finding informants that qualify to provide that information. With the central

questions in mind, a two-week scoping activity was conducted to identify the most important informants for this investigation. We defined 8 key groups of actors: Urban and rural charcoal producers ($n = 55$), traders ($n = 7$), wholesalers ($n = 10$), transporters ($n = 6$), government technicians from the forestry department ($n = 5$), ministry officials ($n = 3$), NGO representatives ($n = 6$) and charcoal association leaders ($n = 3$).

There were four urban charcoal production sites around Pucallpa that were well known to local stakeholders. Within those sites at the time of research we identified more than 160 families producing charcoal. Surveyed urban *carboneros* (charcoal producers) in Pucallpa ($n = 49$) qualified for selection based on status as proprietor or spouse of proprietor of a charcoal kiln. Rural *carboneros* participating in the commercial market ($n = 6$) were selected opportunistically *en route* to or from rural charcoal sites that had been identified by urban producers during interview. We selected homes where charcoal was being produced and the household head or spouse was present. Interviews with Pucallpa sawmill managers ($n = 5$) were solicited in writing in order to understand the source of wood. Representatives of various national and regional governmental and non-governmental offices ($n = 9$) were interviewed in Lima, Pucallpa and Piura to understand official perspectives on the current charcoal market in Peru. Those interviews focused on the legal parameters and bureaucratic paper trail involved in producing, transporting and selling wood-based charcoal, and any perceived difficulties in monitoring and administering these processes. Charcoal wholesale business owners in Lima ($n = 10$) were located through visits to markets and industrial sites, and through interviews with bulk buyers, such as grilled chicken restaurants in Lima, who provided contact information for their charcoal providers. Additionally, we sourced some wholesalers through our connections in Pucallpa. Other actors involved in the trade such as grill restaurants, charcoal packing services, small-scale market sellers in Pucallpa and Lima, street-side sellers and residents neighbouring productions sites were interviewed without questionnaires.

3.2. Questionnaires

We conducted structured, semi-structured and open-ended interviews with participants, and participant observation in the field provided context for insights for the discussion and conclusions. Questionnaires were designed in collaboration with stakeholders and after exploratory pilot work, and we modified the questionnaire design for each participant group. The questions were unique to this study and questionnaires were ground-tested in a pilot by two local field technicians before they were finalised.

4. Results

4.1. Who Are the Actors Along the Supply Chain and What Are Their Roles?

The literature about commodity chains often describes well-defined networks of actors where division of labour is comparatively clear and individual roles are fixed [6,21]. Furthermore, these studies report a pattern of trade that is often relatively linear, with a distinct path between forests and final trading points. In contrast, our research on the commercial charcoal commodity chain in the Peruvian Amazonia is not clear in this way, but rather shares the complex social configuration other researchers have reported about other natural resource industries in the region such as the timber sector [18]. As a result, we found that defining each actor as a discrete category is almost impossible. Additionally, we already knew from the first phase of our research that charcoal is produced from wood from a variety of sources including natural forests, forest clearance for peri-urban and rural agriculture and rural and urban sawmill offsets. Thus, describing the commodity chain in detail becomes even more complex as the network of actors and the links between them grew into an unintelligible web. We have taken some measures to control for an overly complex description of the actor categories, roles and relationships by focusing on principal actors, differentiating between rural and urban production,

and by including transport as a cost and not an actor category á la Ribot (1998) (except in Table 1, where transport actors are included for context).

4.1.1. Actors

We find that the actors involved in the commodity chain can be grouped into three broad categories, according to which part of the production process they are involved in: production (carbonization), distribution and consumption. A full list of the actors we researched and their roles is shown in Table 1 and discussion of overlaps that occur within these categories is found below (Figure 2). Other important actor categories such as administrative agencies and government departments, vendors and wholesalers and primary consumers are included in later discussions.

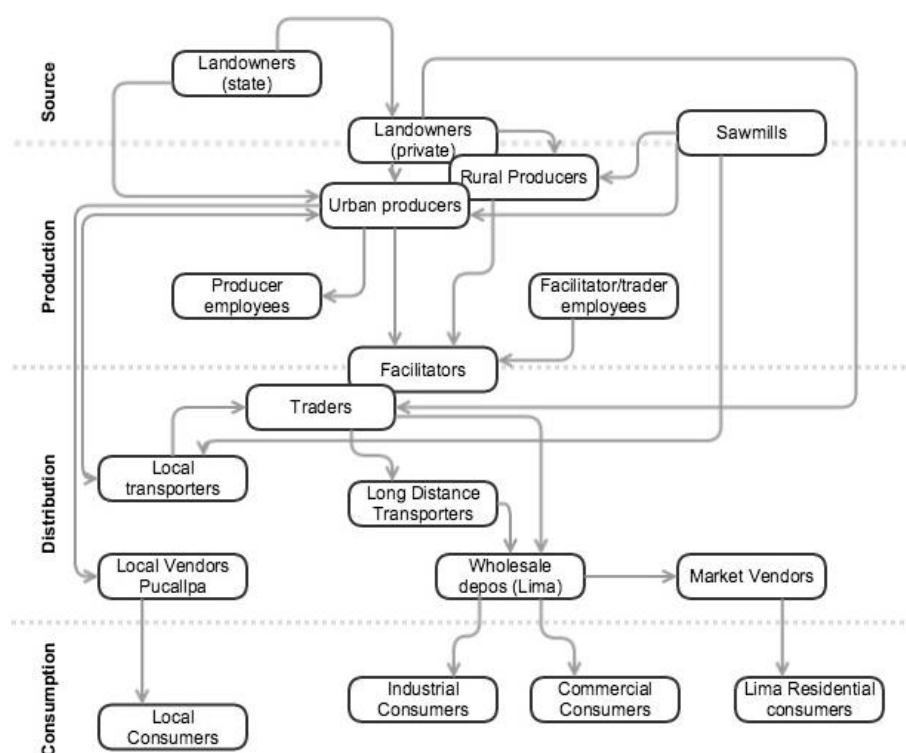


Figure 2. Actor links and vertical integration along the commodity chain. Arrows show links between principal actors. Overlapping categories demonstrate vertical integration between roles boxes and/or place in the commodity chain (dotted lines).

Interviews revealed that actor roles in the commodity chain are relatively flexible depending on their available financial and social capital [22], and vertical integration is common (Figure 2). For example, a trader (*comerciante*) may also be a landowner, he may additionally qualify as a charcoal maker (*carbonero*) if he is producing the charcoal on his own land. Furthermore, if he owns a warehouse in Lima, he could also be a distributor. We did not encounter this level of vertical integration often, but where actors do maintain more than one role they take advantage of economies of scale and their individual profits are far greater. While men were the most active participants in the charcoal supply chain between the Amazon and Lima, there were notable examples of women who displayed a strength of character, power and aptitude for business that is somewhat unusual in the region. We found many women in powerful positions along the chain ranging from producers to traders, *super-carboneros* and wholesalers. Additionally, both the Association for Charcoal Traders (Pucallpa) and the Association for Artisanal Charcoal Makers (Pucallpa), had female presidents, whom we interviewed. Figure 2 shows how roles and actor categories can overlap; this is important to bear in mind for the discussion of equity distribution.

Table 1. Actors and their roles in the Charcoal Commodity chain between Ucayali & Lima.

1. Landowners	Landowners provide space to build charcoal kilns. In rural areas, kilns are frequently built in farm fields, either by the farmer or by itinerate <i>carboneros</i> , to produce charcoal in situ using remnant wood from forest clearance. On public lands itinerate <i>carboneros</i> build kilns in inactive forest concessions using logging waste wood. In urban areas, Timber companies build kilns on property around their sawmills to use mill waste. <i>Carboneros</i> also build kilns on private and public urban lots to transform mill wastes into charcoal. Many producers buy or rent kiln sites, but the government also allow the poor to build on marginal public lands.
2. Sawmill wood transporters (local)	Small-scale entrepreneurs buy sawmill waste-wood to transport and resell at urban kiln sites. Prices vary by distance.
3. Charcoal Producers (<i>carboneros</i>)	All <i>carboneros</i> urban and rural alike utilize artisanal kiln methods.
3.1 Artisanal (rural & urban)	Rural <i>carboneros</i> tend to make charcoal opportunistically as they clear farmland, or else harvest scraps left behind in abandoned concessions and farmlands.
3.2 Super <i>Carbonero</i>	Super <i>carboneros</i> increase the scale of their operations by hiring labour on large plots to manage multiple kilns. They have appeared with the recent increase in value of Amazonian charcoal and are beginning to dominate the market by buying up all the by-product of the quality hardwood <i>shihuahuaco</i> (<i>Dipteryx</i> spp.).
3.3 <i>Carbonero</i> Employees	Super <i>carboneros</i> as well as urban <i>carbonero</i> communities sometimes employ people to tend the kilns, especially at night.
4. Creditors/Facilitators	Creditors lend money and/or goods to <i>carboneros</i> in return for varying degrees of commitment and returns such as reduced charcoal prices or contractual sale agreements.
5. Traders	Traders are the crux of the commodity chain and bear the most fiscal and administrative responsibility for the transport and trade of commercial charcoal. Traders are often also creditors. They buy the charcoal from <i>carboneros</i> , organise charcoal transport to and distribute to wholesalers in Lima.
6. Local Vendors	Local vendors in Pucallpa mainly distribute from the main central markets. They sell sacks half the weight of commercial sacks. This charcoal is inferior in quality because of the wood species used and the small size of the pieces of wood.
7. Transporters (long haul)	Traders hire drivers to transport charcoal in 30,000 kilo loads to Lima. Drivers are often family members or well-known associates of the trader.
8. Wholesale Depository owners	Wholesalers buy vast quantities of charcoal on a weekly basis and distribute in bulk to large urban businesses. Wholesalers are almost always kin of traders.
9. Lima Market Vendors	Market Vendors in Lima distribute to street food sellers, small informal restaurant businesses and domestic clients.
10. Urban Consumers	Commercial and Industrial consumers buy charcoal in bulk from wholesalers. Residential consumers buy from markets.
Principal actors involved in the commercial charcoal supply chain between Ucayali and Lima, their roles and relations.	

4.1.2. How Are Activities and Relations Distributed Amongst and Utilized by Those Actors?

The production of charcoal for urban markets has four principal steps: Extraction of wood or collection of waste wood, processing (carbonization), transport, and sale. In Ucayali, producers told us that they sourced wood from sawmills or collected remnant wood from fields or already logged forests. In Pucallpa, charcoal producers frequently hire middlemen to transport wood from sawmills to kiln sites, although interviews revealed that large operators (the *super-carboneros*) often prefer to avoid paying middlemen by collecting and transporting the wood from the source themselves. Rural charcoal producers usually build kilns close to the source of wood, either on farms in forest areas cleared for agriculture or old logging sites where remnant wood can be found. *Carboneros* also transport wood by boat to kilns built on their own land. Large traders may contract urban *carboneros* to travel along rivers to buy remnant wood from farmers, as was observed during fieldwork.

The charcoal producers surveyed and observed overwhelmingly used artisanal kilns. Artisanal kilns are temporary one-use structures, built by hand using natural materials such as leaves, sawdust, earth and wood pieces and are detailed elsewhere [2]. In the city, charcoal production is usually restricted to certain zones, with up to 50 *carboneros* each with a demarcated plot and working

side by side. There were four principal urban charcoal production zones in Pucallpa and near the highway to Lima at the time of study [2]. More than 164 charcoal producers used these sites including larger-scale enterprises that had formed during the study year—the new “super *carboneros*”—larger-scale family-based businesses that had above average capital to operate on an economy of scale. These were beginning to monopolize a part of the local charcoal market by buying up large quantities of waste wood from preferred tree species from sawmills before anyone else could access them, thereby benefitting from an economy of scale and produce the quality product desired by Lima consumers.

Urban land for charcoal production can be owned by private individuals, sawmill owners or the state. Private landowners run their businesses in three ways; *super-carboneros* that own their own land along the highway hire small-scale artisanal *carboneros* to make the charcoal on their site. The employees are paid a fixed amount per sack produced, but the production itself is technically owned by the super *carbonero*. Other private landowners rent out plots of land, usually in 10 m × 30 m plots, and charge for water used to cool the kilns as the wood is carbonized. Additionally, some of the larger sawmills build temporary and permanent (brick) kilns at the sawmill site and make charcoal with waste wood from their sawmill. Some of the urban charcoal sites are set up on state-owned land and because these producers usually fall within the “extreme poverty” (Extreme poverty in Peru is measured on levels of wellbeing according to a monthly per capita expenditure of less than 143 nuevo soles (approximately US\$52 dollars) (INEI, 2012) demographic bracket, they are not charged rent. It is possible for artisanal *carboneros* to buy land from the state, also sold in multiples of 30 m × 10 m plots. However, this is not straightforward.

Rural charcoal production takes place on farmland cleared for agriculture, on abandoned farmland, in abandoned forest concessions or in unmonitored areas owned by the state. Most rural charcoal is made opportunistically by farmers; as they clear land for crops or pasture, the household transforms the small amounts of wood left in burnt fields into charcoal [23,24]. On a more industrial scale, urban traders (*comerciantes*) purchase rights to access smallholder land to process remnant wood on plots where clearance for agriculture has taken place. In these cases, *carboneros* are brought in from near-by villages, or camps are set up for urban *carboneros* to stay on-site during production. The trader usually pays the *carboneros* a percentage in cash for the total value of the charcoal, which can reach up to 50%.

The transport of wood and charcoal is complex and context dependent. For example, all rural peasant *carboneros* we interviewed explained that to remain independent of traders and creditors (see Table 1) they must find their own finances and means to deliver the merchandise to the main port in Pucallpa. At the port they can find multiple potential buyers and sell to the highest bidder. Alternatively, under contracts with rural communities, traders may collect the charcoal or advance funds to cover the transport costs. Traders transport charcoal from Ucayali to Lima either in their own trucks or in vehicles rented from loggers. There are a few rare cases in which the land-holder in Pucallpa is also the owner of a wholesale charcoal and fuelwood outlet in Lima, however in general landowners in Ucayali do not retail charcoal to national markets, but rather sell to urban traders. Some low-grade charcoal produced in the city of Pucallpa is sold directly to local markets and restaurants, however this only accounts for 1.4% of the total charcoal surveyed.

In Lima, wholesalers buy vast quantities of charcoal on a weekly basis and distribute it in bulk to large urban businesses and urban family food and merchandise markets. Market vendors in Lima distribute to street food vendors, small restaurants and domestic clients.

Relationships between actors were perceived by informants to be good overall, with demonstrated freedom within business relationships to work with others, shop for a better price and cut ties where they were no longer beneficial. However, the perceived good relations should be understood in the context of the strong kinship networks often involved in this supply chain.

4.1.3. The Importance of Kin

Our participant observation work revealed that kinship networks are important at all levels of production and trade, particularly for rural production. An important determinant of market access is the ability to meet the costs of production and trade, which depends a lot on trust between actors as undercutting and cheating is rife [5]. Unlike other business relationships found in this commodity chain, kin networks for the production and trade of charcoal follow relatively fixed social patterns in both rural and urban settings. Rural villages typically consist of a small number of peasant households (usually under 20), many of which are related by blood or marriage. In some cases, we found that relatives and hamlet neighbors established groups to minimize harvest and transport costs. Such informal cooperatives have a ‘principal manager’, which is a community member with connections in the city. The manager will mobilize other community members for the wood collection and the production and transportation of charcoal. The principal manager sometimes trains community members to construct and tend the kilns. More isolated rural smallholders (i.e., those not residing within the hamlet nucleus) rely entirely on family resources, including labor, for charcoal production. Urban *carboneros* also work within tight kin and friend affiliations.

The kin-links of rural and urban *carboneros* groups are generally restricted within the category of production, except when producers are also landowners. In contrast, we observed that *super-carboneros*, traders and lenders are often shrewd in creating strong kin support networks vertically along the supply chain. These connections play an important role in keeping the costs of trading to a minimum and security to a maximum through shared labour, guaranteed sale, secure business (i.e., avoidance of theft by unrelated transporters) and tax circumvention. For example, an urban trader based in Pucallpa will almost always trade with wholesale depots in Lima owned by family members. This exchange is guaranteed. In this case, the family as a whole would (theoretically) pay only the 18% sales tax at the point of final trade, avoiding the tax chargeable when merchandise changes hands between trader and wholesaler. Additionally, long-haul transport is often carried out by relatives of traders, which not only provides security against “theft” (i.e., sale of merchandise by transporters en-route, a phenomena noted by many informants), it also provides more security because the driver has a vested interest to avoid confiscations and will be more willing to attempt bribery at control points.

The new breed of *super-carboneros*—family enterprises that have developed some power at the production end of the chain due to possession of more capital and pieces of land on which they can have many kilns—seemed to be developing business kin-links horizontally rather than vertically so that brothers and sisters work together at all levels of the chain. Rather than grandchildren, children and nieces and nephews answering to a senior family member such as a parent, uncle or grandparent. Several of the *super-carboneros* interviewed were related, often siblings.

4.2. How Are Economic Benefits in Charcoal Trade Distributed Amongst Actors?

As mentioned earlier, field research revealed that the roles in the commodity chain are flexible and involve vertical integration and Figure 2 shows this complexity. Given that traders are the only actors between the Amazon rainforest and Lima required to comply with regulatory paperwork, they bear almost all of the fiscal and administrative responsibility as well as any associated risks for the legal transport and trade of Amazonian charcoal. Nevertheless, they do benefit substantially from their position in the supply chain.

Figure 3 shows the distribution of profit along the supply chain; the chain is according to our surveys, using urban-made charcoal as an example. The calculations are based on the average weight of a bag, which was 102 kg [2] and prices stated in interviews in Lima and rural and urban Pucallpa. A maximum legal load of charcoal is 30,000 kg, so a truck could take just over 290 sacks at a time. Charcoal makers received an average of 55 PEN (17 USD) per sack, which were bought in Lima at an average of 112 PEN (34.5 USD). Input costs for *carboneros* were highly variable depending on available family labour during carbonization (a kiln took an average of 15 days to make the charcoal from start to finish), the price of the sawmill wood, the species and quality of wood available and proximity to

markets. Likewise, the traders had to pay a transport permit fee, truck fuel and sometimes a driver if there was no family member available. There were also frequent and varied bribe costs for traders at the control points en route.

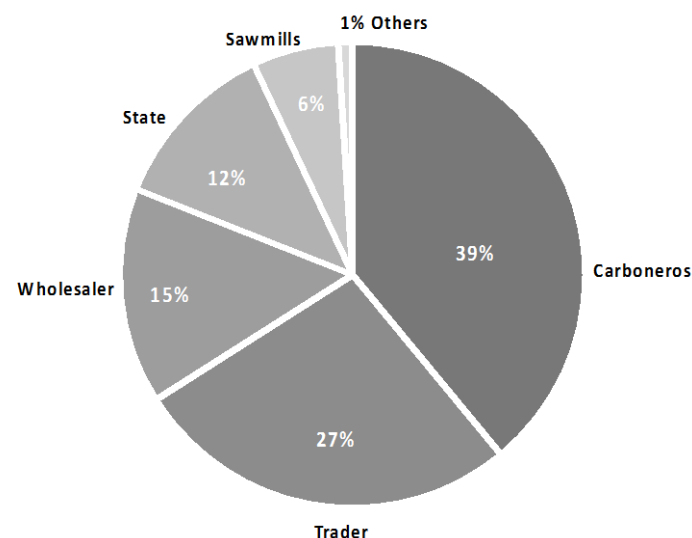


Figure 3. Per-truck load profit distribution across actor groups from charcoal produced in urban Pucallpa and Lima.

In terms of the contribution to the commercial charcoal market, the most numerous actors in this supply chain are *carboneros*. However, the survey result shows that the highest per capita share goes to the traders while wholesalers in Lima handle the largest quantity of charcoal due to their relatively small number, links with charcoal coming from other departments such as Piura and their position in the commodity chain. Although the data show that the *carboneros* receive the largest share (39%) of a given truckload, this share was divided amongst several *carbonero* contributors because the charcoal output of several small producers is needed to complete a load. Traders are the actors that benefit most on an individual level with considerable concentration of profits, reaping the full 27% margin.

Officially, traders should be paying 18% income or sales taxes, although it is not clear that these amounts are paid in practice, given the informal nature of this trade. With informants claiming to pay 12% in taxes overall (we were not able to verify this with any state office), the state seems to derive less revenue from charcoal production and trade than expected. There is likely to be some measurement elasticity in these figures as income distributions are surely skewed by variables such as vertical integrations, multiple roles of any one individual actor, money lending scenarios, corruption and bribes, confiscations, and rural informal cooperatives. However, our data does account for the majority of the more fixed costs for production of charcoal such as the purchase of fuelwood and administration, transport and taxation costs.

Survey data shows that charcoal accounts for 19% of total sawmill income, 97.5% of urban artisanal *carbonero* income, and 43% of rural *carbonero* income. Furthermore, when measured in the Likert scale (Scale: 1. Not important 2. Of little importance 3. Important 4. Somewhat important 5. Very important), most (77%) rural charcoal makers ranked charcoal production as important while 86% of urban producers ranked it very important. This might be explained by factors such as the prevalence of alternative income sources, expertise, and exhaustible supply of by-product in rural settings. Access to credit is of course a limiting factor, with more opportunity concentrated in urban areas. Wholesalers sometimes extend credit to producers for bulk purchases. Most of this goes unmonitored and it is also untaxed. Whether this is viewed as a missed opportunity for national revenue collection, or a substantial contribution to local poverty alleviation depends on one's standpoint on debates about regional development.

4.3. What Are the Obstacles to and Opportunities for a More Equitable Charcoal Supply Chain in a Governance Context?

In addition to the positive elements of this commodity chain reported so far, it also involves areas of complex networks of financial and social capital which enable each actor group to protect itself from the uncertainties of working with the others. This is reflected in rural informal cooperatives, kinship ties and long-term working relationships, for example. However, despite informants' claims about the good relations amongst actors, our field investigation revealed a scenario far from an even playing field in Ucayali and—as is the case in many nations and regions—it is easy for those with capital to get ahead [25]. Operating within informal markets, nested within decentralized governance of natural resources which involve both governmental and non-governmental actors, the elite charcoal traders are able to influence government decisions whereas more marginalized groups are unable even to access government services. This section uses case studies to illustrate the on-the-ground reality of this supply chain to identify the obstacles and opportunities for discussion.

Case Studies

As we mentioned earlier, in Pucallpa, we found an established *Association of Charcoal Traders*. This association was quickly set up in response to traders' concerns about an additional tax payment they say was in place (we were unable to verify the existence of this tax), which they perceived to be unfair because they were already making contributions to the state through the existing administrative system. They were able to set up the association in nine months, hire an environmental consultant to investigate the circumstances and deliver a report to the local authority. The final outcome was the cancellation of the tax. Since the establishment of the association, the local government has even decided to delegate some administrative responsibilities to the association by authorizing its leaders to distribute ('sell') waybills to traders. The *Association for Artisanal Producers* on the other hand, has struggled to gain formal recognition since 2006. One source of difficulty is that they cannot afford to pay fees required by the administrative process as well as associated bribes to seal the deal. This means that urban *carboneros* must continue to work as an 'informal economic activity' and remain vulnerable to the whims and prejudices of urban citizens and of local, regional and national authorities. It also provides further evidence of the multi-level nature of the governance system: in some cases, private sector actors are able to change the rules of the game (abolish taxes) and secure access to services (legalize their associations) whereas others are excluded from access to the formal system (small-scale producers).

Some other case study examples further strengthen this point, and highlight the underbelly of the charcoal supply chain, where the government is more involved than it may appear on the surface. In the four charcoal production zones in Pucallpa, a distinct smell of smoke emanating from the artisanal kilns is apparent. As the population in Pucallpa has grown and settlements around these zones have expanded, many residents have developed an aversion to the smoky atmosphere. Under the rubric of 'development', 'health' and 'environmental concerns' and (supposedly) in response to complaints and petitions, various factions of the regional authority have attempted to relocate and/or educate urban *carbonero* populations. For example, the *Regional Office for Environmental Management* revealed plans to 'clean up' the charcoal industry in Pucallpa through measures such as relocation (further away from settled populations), education (about negative health effects of the smoke), training (on how to manufacture charcoal more ecologically) and stricter regulations (not yet defined). In fact, the regional government has already relocated one of our research sites (39 *carboneros* at the time of study) once in the past. Incidentally, when we returned to this site in late August 2014, we found a settlement of more than 400 new households bordering the charcoal production site, many of the homes encroaching on the 200 m buffer zone limit required between charcoal zones and human settlement, as decreed by health and safety laws in Pucallpa. The owner of the charcoal site informed us of his intention to relocate due to the many problems caused by this sudden urban human settlement and their objections to the charcoal site.

Finally, there is a plethora of other administrative agencies, both public and private, that affect environmental, economic and social aspects of charcoal making along the commodity chain, sometimes contradicting and undermining each other. At one point or another, the entities overseeing the sector have included local authorities, such as the environment division of the municipal government, as well as decentralized administrative units such as the Ministry of Health (MINSA) offices representing the Ministry for the Environment (MINAM), its ancillary branches and privatized administrations like the tax authority (SUNAT) and independent research consultancy agencies. Most of these groups work independently of one another and there is no mechanism in place for knowledge or resource sharing amongst them. For instance, we found that over the same four-year period MINSA, a Lima based consultancy agency hired by MINAG, and the Association for Education and Health Development (ADESA) [26] had all conducted similar research on the air quality around charcoal production sites in Pucallpa. The use of state resources to conduct such studies and reports are justified by notions of ‘health’, ‘environmental protection’ and ‘progress and development’, but historically their actual outcomes have been half-hearted, short-lived development projects, and the consistent harassment of the poorest actors along the supply chain (artisanal *carboneros*).

Although these plans for changing the production of charcoal seem positive, many of them lack grounding in the reality of how *carboneros* live and work and consequently interventions are perceived by *carboneros* as useless or, worse, as a very real threat to their livelihoods. This is partly a result of the complexity of the actor network involved in the supply chain but also of the failure of the government agencies to understand the complexities of the supply chain and obstacles to economically viable production. Despite devolution of governance to regional and local authorities who should, in theory, be more aware of the peculiarities of local production systems, policies around charcoal have failed to adequately adapt to local realities. To begin with, the further the *carboneros* are from the sawmills, the more they have to pay the middleman to deliver the wood for the charcoal. This alone is enough to push some of the poorest *carboneros* out of the market. Second, some of the proposed sites for relocation have no access to water, which makes charcoal production using traditional artisanal methods impossible as water is used to cool kilns throughout the production process.

Education and ‘training’ has mainly involved speaking to *carboneros* about how to make and use permanent ‘beehive’ shaped kilns made of red brick, which are perceived to be more ecological and healthy as they theoretically burn less wood and produce less smoke. We were able to find information about two projects based on this theme, one in the 1980s and one in the past five years—though *carboneros* claim there have been a lot more. There are several problems with the suggestion of permanent beehive kilns in Pucallpa. Firstly, most *carboneros* cannot afford the materials needed to build them. Secondly, to maximize the efficiency of permanent beehive kilns (and avoid the burning of the charcoal) they must be filled to the top. This requires a large amount of fuelwood, which is often not available to individual *carboneros* due to low supply and/or the cost of buying in bulk. In addition, many of the charcoal production areas flood for 4–5 months of the year, therefore the permanent kilns would be submerged and likely damaged. Finally, most *carboneros*, like many other citizens in Pucallpa, migrate between rural and urban livelihoods and activities and move regularly, following work or family or in response to other living conditions. It is therefore not in their interest to invest in permanent kilns.

To find a policy and practical solution for air contamination, the authorities need to consider that artisanal kiln building is likely the only method of production that is going to work for the small-scale producers in Pucallpa. Therefore, government resources would be better placed researching how traditional kilns could produce less smoke while maintaining the quality of the charcoal [26,27]. For example, we met with the owner of a pioneering sustainable charcoal company in Sullana, Piura northern Peru who has spent 25 years developing and perfecting a subterranean kiln that produces almost no smoke. Whether or not such a system would work with Amazonian soils is unknown, however experimentation of this kind might be a better and more economical way to spend state funds than recruiting agencies from Lima to measure air contamination, for example.

This case study shows that aside from the small official income that the state (allegedly) derives from the formal trade of charcoal, and the policies it creates to control that trade, the government at various levels is heavily influencing the commodity chain in several indirect ways. It generates and disseminates information on the negative health and environmental impacts from charcoal production. Its enforcement of regulation favors politically and economically powerful actors over others. It is responsive to constituent complaints against charcoal makers. Additionally, the state has designed regulations that are not tailored to local realities; it enforced these regulations in an ad hoc way which allows corrupt practices and rent seeking behavior to persist.

One final case study demonstrates that even where regional authorities do attempt to use their local knowledge to apply appropriate formalization procedures, the current decentralizing system inhibits their effectiveness due to the layers of rules and regulations imposed from the national level. Efforts by regional governments to ensure sustainable use of forest resources are (at least in theory) framed by the Forestry and Wildlife law. The extraction of forest resources requires prior authorization, including proof of land ownership and field visits by forest authorities to verify extraction is happening in a legal manner. In practice, the forestry department says that only one application for the production of charcoal in rural Ucayali has been made for many years, and this one application was made by a large concession.

The regional office in charge has built on its local knowledge to complement the forestry law by developing a permit system for charcoal produced in the city from sawmill waste. A central government memorandum (MINAG memorandum no. 2681–2006) stipulates that sawmill residual waste and any products derived from waste do not need to undergo the administrative process or obtain a permit for the legal transportation of forest products. This regional permit system bypasses normal administrative processes for forest products, requiring traders only to acquire and pay fees for a ‘transport permit’ for specific quantities of charcoal (up to a maximum of 30,000 kg—or one truck load), a receipt for a ‘visual inspection’ of the produce and a ‘waybill’ for the charcoal merchandise. The regional authorities have not, however, been able to extend this permit system to rural farm (*chacra*) charcoal to allow the use of remnant wood found on rural properties.

Land tenure complications such as informal land ownership, titling processes and migratory populations, and lack of understanding in some regional and central government offices (where laws are passed and administered) of how the commodity chain works mean that regional and local authorities have been unsuccessful in their appeal to the central government to grant permission for such permit procedures in rural areas. This problem is entirely due to the large size of the pieces of charcoal that are produced in rural areas compared with the easily identifiable smaller, machine cut pieces that come from sawmills. The lack of understanding about how charcoal is produced, coupled with the lack of government presence in rural areas to monitor and enforce the forestry law, means these much larger pieces of ‘chacra’ charcoal are assumed at check points to be the result of smallholder-led deforestation. Finally, the migratory nature of many of Ucayali’s rural inhabitants means that the standard tenure requirements for forest resource exploitation permits are unsuitable. The fact that many rural peasants do not have legal titles, are squatting on land owned by others, and are migrating up and down rivers and roads or are invading abandoned concessions excludes them from legal permits to harvest logging waste products in rural areas even if the rest of the issues were solved.

5. Discussion

The premise of decentralized governance is simple: people at the local level have direct experience of the situation, and are therefore more likely to have meaningful ideas on how to solve problems [28]. The closer decision-making is to a given situation the more likely that decision makers will be able to respond appropriately to plan, monitor and control the activity. Furthermore, it is hoped that decentralized systems will be more cost effective, allow for clearer accountability, and make tax circumvention less common [29–31]. However, while some authors have argued that decentralization

can improve local accountability and the relevance of government policies to local realities, others question its susceptibility to corruption and elite capture [32]. In many ways, the case of charcoal in Ucayali shows evidence of both increased relevance (e.g., the local permit system for sawmill waste) and elite capture/corruption (e.g., bribes and abolition of taxes).

The case of charcoal in Peru illustrates the complexity of this debate. In terms of obstacles identified in this research, the first is the decentralization process itself. Even though this process began in Peru in 2002, by 2018 decentralization is as yet incomplete, and Peru remains a *de facto* decentralizing state [33] governed by multiple actors (state and non-state) at multiple levels (from local to national). Furthermore, the existing informal and formal institutions and their respective inequitable practices, shape how decentralization takes place in practice [7]. Although subnational governments now have more power to make decisions in terms of public resources and autonomy, we see that they do not yet have enough resources, adequate skills or perhaps even the cultural inclination to discharge these new roles so that even where knowledge and political will was present at the regional level, it had no political weight to make meaningful change. A similar context is likely to be found in other regions in Peru and other developing countries where informal commerce and livelihoods are a main staple of the historical political ecology of the region [18,34].

There is also a conceptual obstacle here, where such a socio-political system confuses or blurs the meaning of informality and illegality. Attempts are being made by governments and development agencies (often unsuccessfully) to mainstream and control (and even prohibit or sanction) production and exchange of products that have historically comprised part of informal markets. This paper has shown that in the case of Amazon charcoal in Peru this blurry line means that—intentionally or unintentionally—scapegoating and corruption can thrive. For example, as we discussed in this paper, while environmental damage discourse is mainly levied against the poor producers in this supply chain for alleged deforestation and air contamination, authorities pay little attention to the activities of the more powerful actors, such as the large-scale businesses that buy and burn the end-product for great profit. This is a potential opportunity for re-balancing trade and political equity along this supply chain first identified elsewhere [2]. As this article goes to press the Peruvian government have begun to discuss implementation of such policies (though only for illegal charcoal) in Peru [35].

Nevertheless, field observations suggest that it is likely that informal livelihoods remain strong, culturally acceptable and a normal way of life for local and regional actors, including those in the government. It could be that this very historical political economy of informality what has kept informal livelihoods in Peru at more than 65% (2016), accounting for 97% of agricultural workers and 99% of the low wage cohort. This is a common phenomenon in developing countries around the globe, especially those with rural economies strongly based on agricultural or natural resource products. In the Peruvian Amazon, the production and sale of agricultural commodities is tax-free, in order to support rural development and bolster struggling rural economies. A closer collaboration between stakeholders involved in evaluating the need to absorb informal activities into formal systems at multiple levels of governance and society would help identify where there is a real need to disrupt or interfere with established informal economies, and where informality can be seen as an opportunity rather than an obstacle to poverty reduction. In this case it would be particularly important to involve and empower but also oversee and support local governance systems that understand the local political economy. For example, as we saw in the case study, forestry agents do not make trips down rivers and highways to monitor and control illegal or quasi-legal charcoal production. Again, it could be plausibly claimed that the absence of control in rural areas is explained by the lack of resources to achieve those ends as the forestry authorities are not well supported financially, administratively or in terms of professional development [36]. However, alternatively, authorities may avoid expending resources to regulate rural charcoal production because local forestry agents know that (a) tree felling for charcoal production is rare in this part of the country, and (b) a high level of informality is simply accepted as a way of life or (c) it is used as a way to ‘get ahead’ by always keeping the poorest as

vulnerable as possible. We see here both potential obstacles and opportunities, depending on how the political decentralization is supported by other levels of governance.

Thus, whether formalization of activities such as charcoal production would improve the outcomes for the poorest in the supply chain depends on the manner in which formalization takes place. Problematically, ‘formalization’ often involves complex bureaucratic procedures that are inaccessible to the rural poor. As a result, the old informal system can seem more appealing, perpetuating the imbalance of power. This situation plays in favor of the more powerful actors who feign formalization through activities that are not necessarily sinister if not chaotic and arbitrary—as our case studies highlight.

The success of a decentralized political system depends on a meaningful discourse between citizens and local government so that the state as a whole is in a position to develop more appropriate policy at a finer spatial scale. The decentralization of the forest sector in Peru is characterized by a series of rapid modifications to the institutional and legislative infrastructure, which made it a good case study for analyzing these issues. However, very recent reports indicate that the Peruvian government has now recognized the environmental and financial skew in the charcoal commodity chain with regards the biggest consumers: the Lima grilled chicken restaurants. This indicates a positive engagement with the multilevel knowledge generated along the chain, and an opportunity to balance out equity along it.

6. Conclusions

Whether governmental institutions are able to create and implement appropriate environmental policies, development projects and poverty alleviation strategies is directly linked to their level of understanding of local conditions and processes. The success of such programs is increasingly dependent on the ability of newly decentralized local authorities to identify what businesses exist, understand how they operate in reality and engage with these local markets in a meaningful way. However, when informal livelihoods form the cultural foundations of the historical political economy of a place, inappropriate policies based on disengaged state-civil society relations will be ignored and contested where they disregard established and accepted traditions of market organization and exchange, limit profits, constrain powerful or important individuals along the chain, or criminalize and sanction production activities.

Although we found some encouraging examples of the regional forest authority using its local knowledge to develop an administrative system that supports local charcoal commerce, we found more instances in which the local and national authorities had completely (unintentionally or intentionally) misread or ignored how the mechanisms of the charcoal commodity chain work. This has had some unfortunate consequences for actors who depend on charcoal as a source of income. Tighter administrative links between the decentralized offices including knowledge and resource sharing would help develop meaningful and appropriate supervision and control. Additionally, more dialogue between local authorities and central government on an as-needed basis might encourage appropriate policy development closer to the ground at a manageable pace. This is illustrated by the rural charcoal permit case study described in this paper, where local authorities have been denied the right to implement a suitable permit system for a sustainable forest resource industry.

Under the rubric of participatory development, state and project level agendas are increasingly focused on developing forest-community empowerment to bring benefits from natural resources and their products closer to the source [37–39]. This charcoal commodity chain poses almost no direct threat to forests, while at the same time contributing substantially to rural and urban poor household incomes at the source of the supply chain, albeit in a seemingly inequitable way. While it poses some social and health problems locally, it seems unfortunate that these problems occupy the forefront of development agendas, and that proposed solutions disregard the needs and constraints faced by *carboneros*, some of them among the region’s poorest families. A lack of conceptual and administrative coherence within the formal institutional frameworks set up around charcoal production and trade

means that the regulatory process itself can often become so disengaged from the reality of the informal side of the industry that it loses opportunities to support small players, and profit from the larger ones such as the *super-carboneros* and the grill restaurants through taxes and fees.

The focus on displacement and disenfranchisement of urban producers, rather than a proactive effort to make the situation work for everybody exemplifies this. Furthermore, as the market for charcoal grows, the socioeconomic configuration of the commodity chain has been evolving. We have illustrated this through our discussion of emerging equity issues as the *super-carboneros* become more powerful. In addition to the new legislative changes proposed for sanctioning the purchase of illegal charcoal by Lima-based restaurants, differentiation between the treatment of *super-carboneros* and artisanal producers might be a way that regional government could simultaneously reconcile lost revenue and back poverty alleviation efforts. Finally, understanding consumer demand for charcoal in big cities is a critical next step for research, because where there is demand, it will be met. A further interesting aspect of the Amazonian charcoal supply chain worth further study is that of gender and empowered rural women involved in charcoal commerce at various levels. In terms of policy and development, this is particularly relevant now, since gender equal livelihoods is at the forefront of sustainable and equitable rural development agendas in many of the ministries in Peru, and at the international level through aid and development programs run by institutions such as the United Nations, to name but one (For example, in 2018 the International Fund for Agriculture Development (IFAD) had ‘gender’ as one of its principal target areas for rural development support (together with youth and climate change). Additionally, The United Nations Population Fund has gender equality as a primary development challenge in Latin America and beyond.).

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